From:	Wait, Monica
To:	Rowland, Grant; Schmid, Emily
Cc:	Sankula, Sujatha; Radtke, Meghan; Hetrick, James; Khan, Faruque; Montague, Kathryn V.; Kenny, Daniel
Subject:	FW: Evaluations of Environmental Fate Studies(PC Codes 051505; DP Codes 402860, 403363,414416, and 405216
Date:	Monday, January 13, 2014 1:56:47 PM
Attachments:	051505_402860+ DER-Memo_11-18-13.pdf 051505_402860+ DER-Memo_11-18-13.docx 051505 48862901 DER-Fate_Non Guideline_11-18-13.docx 051505_48844001_DER-FATE_840.1200_11-18-13.docx 051505_48844001_DER-FATE_840.1200_11-18-13.pdf 051505 48862901 DER-Fate_Non Guideline_11-18-13.pdf 051505_48912102_DER-FATE_835 8100_11-18-13.pdf 051505_48912102_DER-FATE_835 8100_11-18-13.docx

2 of 2

From: Khan, Faruque
Sent: Tuesday, November 19, 2013 9:23 AM
To: OPP EFED Tracking Team
Cc: Sankula, Sujatha; Wait, Monica; Montague, Kathryn V.; Walsh, Michael
Subject: FW: Evaluations of Environmental Fate Studies(PC Codes 051505; DP Codes 402860, 403363,414416, and 405216

Attached files are eCopies of the above actions. If you have any questions or comments regarding this action, please let me know.

Thanks.

Faruque Khan
305-6127

Test material:

Common name: 2,4-D and glyphosate
Chemical name: 2,4-D and glyphosate

MRID 48862901

EPA PC Code 051505

OCSPP Guideline: Not applicable
OECD Data Point: Not applicable

Primary Reviewer: [*Faruque Khan, Senior Scientist, EFED, ERB1*]

Date 11/18/13

Secondary Reviewer: [Stephen Wente, Biologist, *EFED, ERB1*]

Date 11/18/13

Droplet Size Measurements for Spray Drift

Report: MRID 48862901. Wilson, S.L. and A.J. Hewitt. 2012. Wind Tunnel Droplet Size Measurement for Sprays Containing 2,4-D and Glyphosate. Unpublished study performed by Dow AgroSciences LLC. Activities to Products Research and Development, Dow AgroSciences LLC, Indianapolis, IN 46268 and the Center for Pesticide Application and Safety; University of Queensland, Gatton Qld 4343, Australia. Study ID. NAFST-12-141. Experiment initiation 5/1/2010 and completion 6/12/2012 (p. 3).

Document No.: MRID 48862901

Guideline: Not applicable

Statements: This method was not conducted according USEPA GLP Standards. Signed and dated statements of Data Confidentiality and GLP were provided (pp. 2-3).

Classification: The Agency finds that the experiment meets the criteria for a scientifically valid study and provides **ancillary** information.

PC Code: 051505

Reviewer: [*Faruque Khan, Senior Scientist, EFED, ERB1*

Signature: Faruque C. Khan **Date:** 11/18/13

EXECUTIVE SUMMARY

A wind tunnel study was conducted to evaluate droplet size spectra for four mixtures of 2,4-D and glyphosate using 4 different nozzles. The 4 nozzles were TeeJet Extended Range (XR), Turbo TeeJet (TT) and Air Induction Extended Range (AIXR) types, and a Hypro Ultra Low Drift (ULD) design. A laser diffraction spatial sampling system was used for this study. Sampling for all spray solution and nozzle combinations were made at 3 different air speeds (1, 7, 15 mph) and 2 laser distances (15, 50 cm) from the nozzles in order to optimize droplet size sampling techniques for ground sprays. For a given spray mixture and nozzle combination, the measured sprays were generally observed to become coarser as the measurement distance decreased and the air speed increased. Study authors concluded that the findings are consistent with the previous work showing that sufficient concurrent air velocity coupled with a minimization of the nozzle to laser distance is necessary in order to minimize the potential for spatial sampling artifacts due to small droplet deceleration. This study has demonstrated that variations in concurrent air speed and measurement distance can have a pronounced influence on spray droplet distribution results. This study is scientifically valid and provides **ancillary** information.

A. BACKGROUND INFORMATION

The emission droplet size spectrum formed by the atomization of a pesticide is affected by many application conditions (nozzle type, pressure, etc.) and tank mix physical properties of tank mix (e.g. dynamic surface tension, viscosity etc.). The current study was conducted to compare droplet size data measured at different air speeds and sampling distances, with a goal of determining the best combination of measurement distance/air speed in order to obtain the best representation of the spray droplet size distribution immediately after droplet formation upon exiting the nozzle. Droplet size distribution is a critical input for spray drift modeling programs such as AGDRIFT and AGDISP.

B. Materials and Methods

All the test was conducted in a wind tunnel. The wind tunnel air speed was set to 1, 7 and 15 mph for sampling the sprays. The laser was positioned at 15 and 50 cm downwind of the nozzle. Droplet size was measured using a Sympatec HELOS VARIO laser diffraction particle size analyzer (Sympatec GmbH, Clausthal-Zellerfeld, Germany) using standard test methods used for previous studies such as those of the Spray Drift Task Force (SDTF). All measurements were replicated to provide three measurements per treatment, with average data being reported for each application. Various spray solution and nozzles were used in this study and are listed below.

Spray solution.

The following herbicides were used in the study:

1. Weedar 64 (Nufarm), 456g a.e/L (38.9 wt%) 2,4-D
2. Roundup PowerMax, - 540g a.e. /L (39.8 wt%) glyphosate
3. GF-2726, 205g a.e./L(17.5 wt%) glyphosate + 195g a.e/L (16.6 wt%) 2,4-D
4. GF - 2727, 205g a.e./L(17.5 wt%) glyphosate + 195g a.e/L (16.6 wt%) 2,4-D
5. GF - 2778, 205g a.e./L(17.5 wt%) glyphosate + 195g a.e/L (16.6 wt%) 2,4-D

The above formulations were diluted in ambient tap water for evaluation in the wind tunnel, using typical anticipated use rates of 800 g/ha 2,4-D and 840 g/ha glyphosate and a typical application volume rate of 93.5 L/ha (10 gal/acre) to yield the following treatment mixtures:

1. Weedar 64 @ 1.75L (2.20 wt%) + Roundup PowerMax @ 1.56 L/93.5L (2.26 wt%)
2. GF-2726 @ 4.10L / 93.5L or 5.13 wt% product in spray solution
3. GF-2727 @ 4.10 L / 93.5L or 5.13 wt% product in spray solution
4. GF-2728 @ 4.10 L / 93.5L or 5.13 wt% product in spray solution

Nozzles

The following nozzles which were tested at a spray pressure of 40 psi:

1. TeeJet 11002 XR (conventional flat fan)
2. TeeJet 11002 TT (Turbo Teejet)
3. TeeJet 11002 AIXR (Air Induction)
4. Hypro2 12002 ULD (Ultra Lo-Drift) nozzle

Table 1. The following descriptors were used to indicate the droplet size for each treatment

Droplet Size	Description
Dv0.1	10% of the volume of the spray is contained in droplets smaller than this diameter
Dv0.5	50% of the volume of the spray is contained in droplets smaller than this diameter. (This value is commonly called the Volume Median Diameter (VMD)
Dv0.9	90% of the volume of the spray is contained in droplets smaller than this diameter
Vol. < 150 µm	Percentage of the total volume contained droplet sizes less than 150 µm

The complete data set, including graphical representation and a tabular summary of the entire spray output distribution for each of the spray mixture/nozzle combinations, with statistical analysis of replicates were presented in Appendix A in the study report.

C. RESULTS AND DISCUSSION

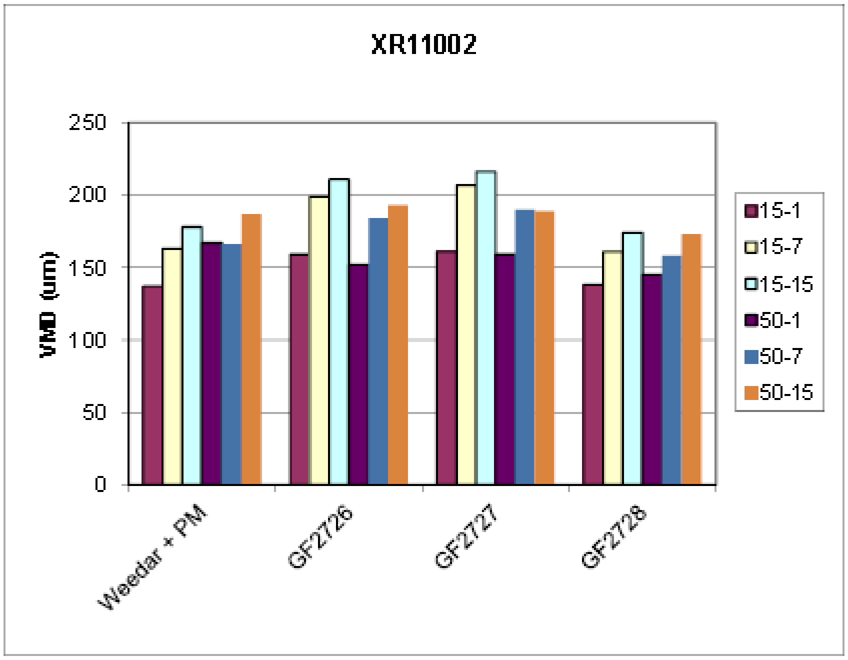
The spray droplet distribution analysis results for each combination of spray mixture, nozzle, air, and speed measurement distance are summarized in Table 1(Appendix A; Pages 11-14) in the study report. The distribution analysis results were calculated from the complete droplet distribution spectra (Appendix A of the report; Pages 23-184). An example of Sympatec spectrum is included in Appendix B. The sprays were mostly mono-modal with a single peak in the volumetric droplet size spectra and the replicate measurements are very similar.

The following figures 1 through 4 depicted the droplet size data for Volume Median Diameter ($D_{v0.5}$) and the percent spray volume contained in droplets with diameter below 150 µm for each treatment by nozzle type and tank mix. For a given spray mixture and nozzle combination, the measured sprays were generally observed to become coarser as the measurement distance decreased and the air speed increased. As the laser sampling distance increased from 15 to 50 cm from the nozzle tip, the measured spray size distribution generally became finer or remained unchanged with a few exceptions of becoming coarser (e.g TT 11002; GF2728). Study authors suggested that for AgDRFIT and AGDISP modeling purposes, it is important to sample at a distance that is large enough to allow representative sampling without measuring an incompletely atomized sheet or ligament of liquid, while also being appropriately short for avoiding a size and velocity profile within the spray or loss of larger droplets by gravitational settling prior to crossing the laser beam when sampling horizontally as in a wind tunnel.

This study suggests that variations in concurrent air speed and measurement distance can have a pronounced influence on spray droplet distribution results. As the sampling air speed increased from 1 to 7 to 15 mph, there was an increase in the reported spray coarseness as indicated by an increase in $D_{v0.5}$ and a decrease in the fine droplets (%V<150μm). This generally applied to all nozzle types and spray mixtures (Figure 1 to 4).

D. ACCEPTABILITY/DEFICIENCIES/CLARIFICATIONS

Raw analytical data were submitted, so reviewers were able to confirm the reported drop size distribution and statistical analysis. There is no major deficiency observed in the submitted study. However, if this study is intended to relate nozzles similar to AIXR11004VP nozzle used in field spray drift determination (MRID 48844001), this study should have included AIXR 11004VP nozzle. In addition, no reference nozzle was used in this study. It is highly recommended that data generated using reference nozzles should also be included when measuring droplet size spectra to insure data quality (Fritz et al., 2013).



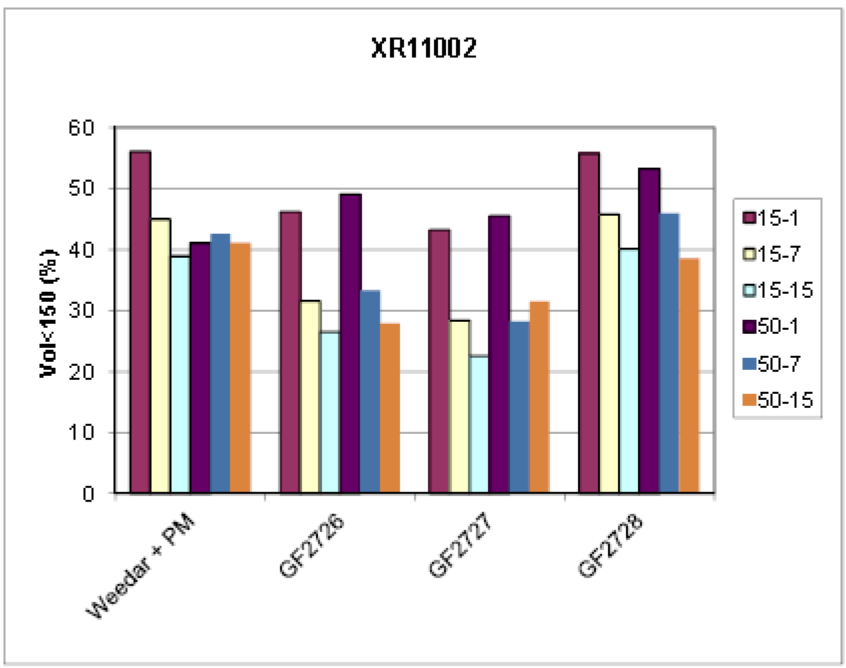
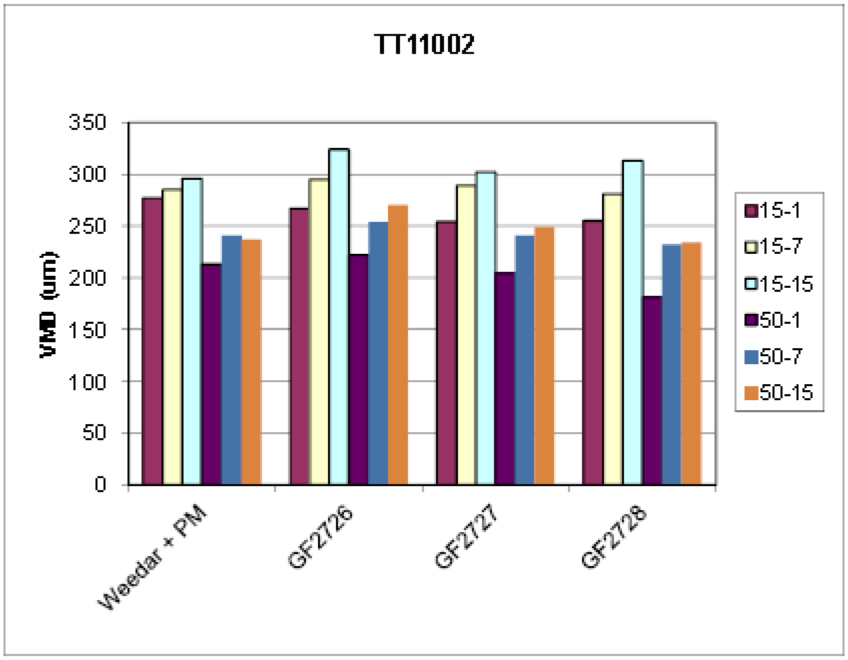


Figure 1. The droplet size data for Volume Median Diameter ($D_{v0.5}$) and the percent spray volume contained in droplets with diameter below 150 µm for nozzle XR 11002 using various tank mixes at 15 and 50 cm sampling distances at 1, 7, 15 mph airspeed



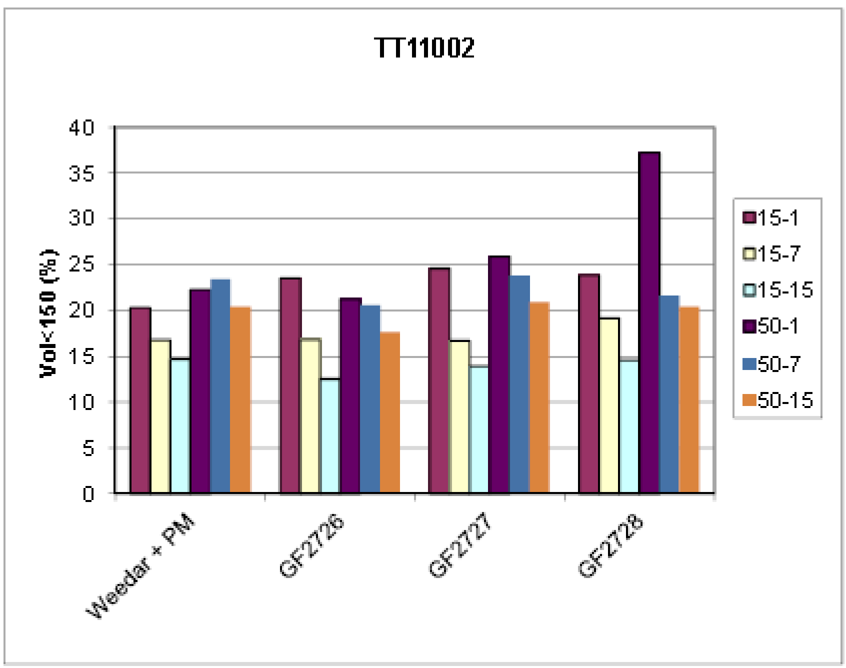
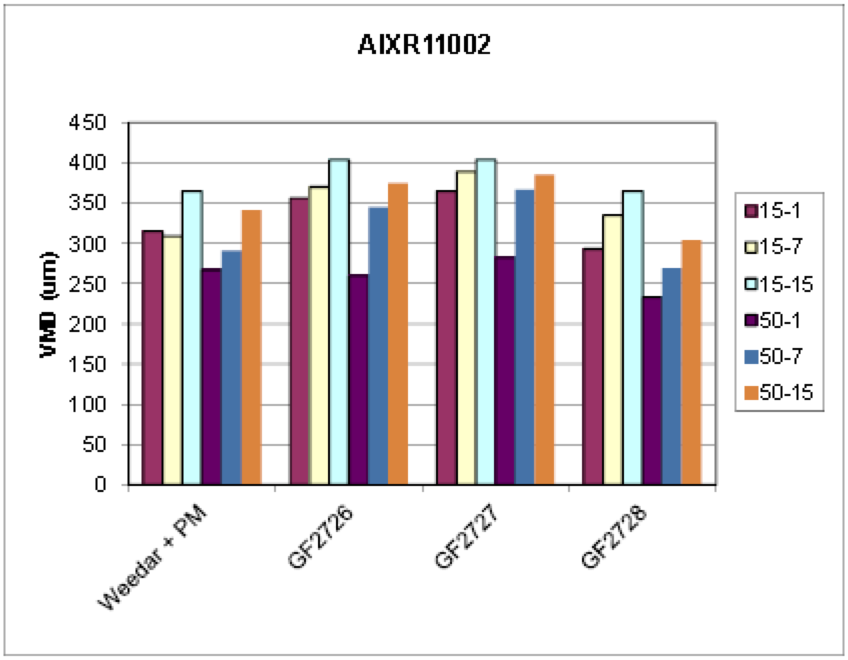


Figure 2. The droplet size data for Volume Median Diameter ($D_{v0.5}$) and the percent spray volume contained in droplets with diameter below 150 µm for nozzle TT 11002 using various tank mixes at 15 and 50 cm sampling distances at 1, 7, 15 mph airspeed



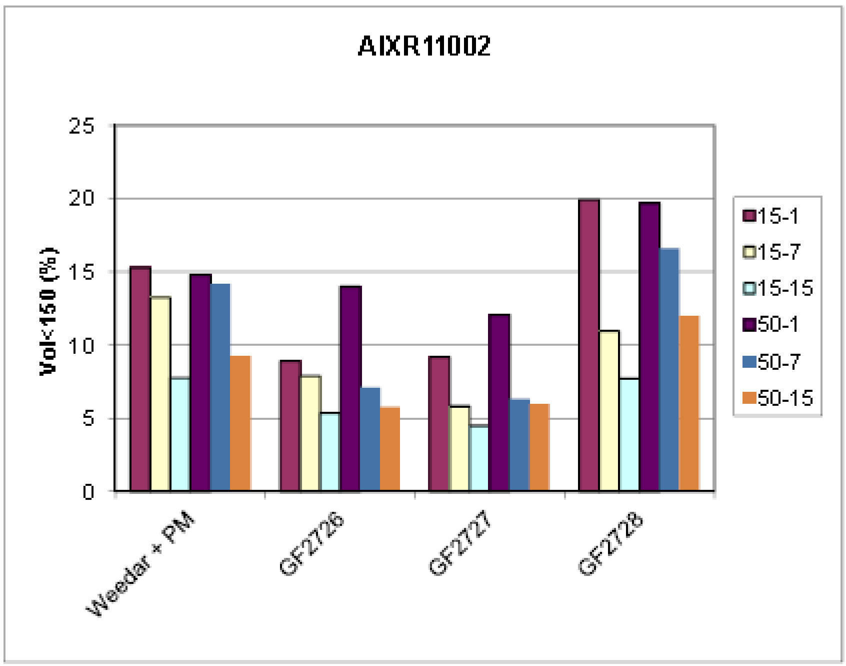
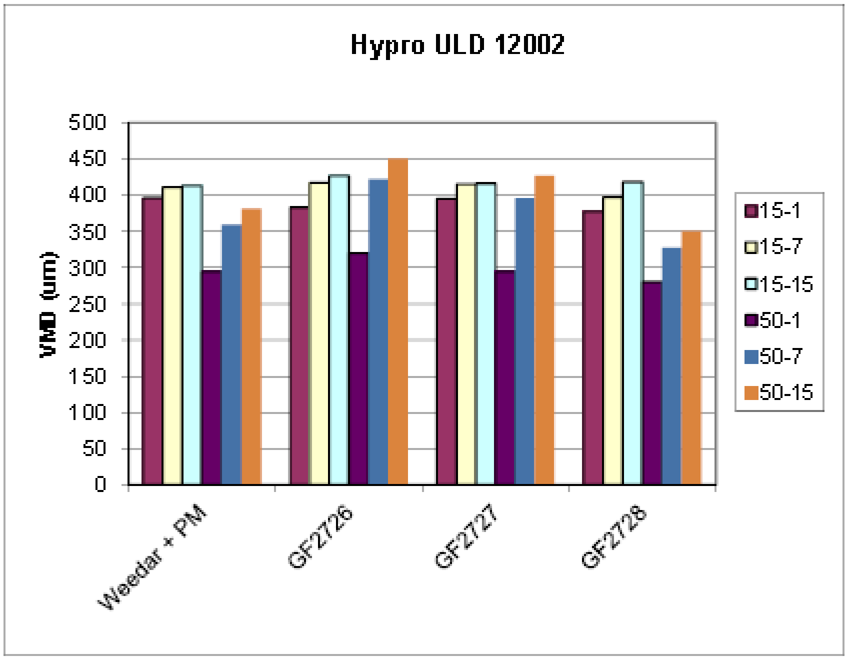


Figure 2. The droplet size data for Volume Median Diameter ($D_{v0.5}$) and the percent spray volume contained in droplets with diameter below 150 µm for nozzle AXIR 11002 using various tank mixes at 15 and 50 cm sampling distances at 1, 7, 15 mph airspeed



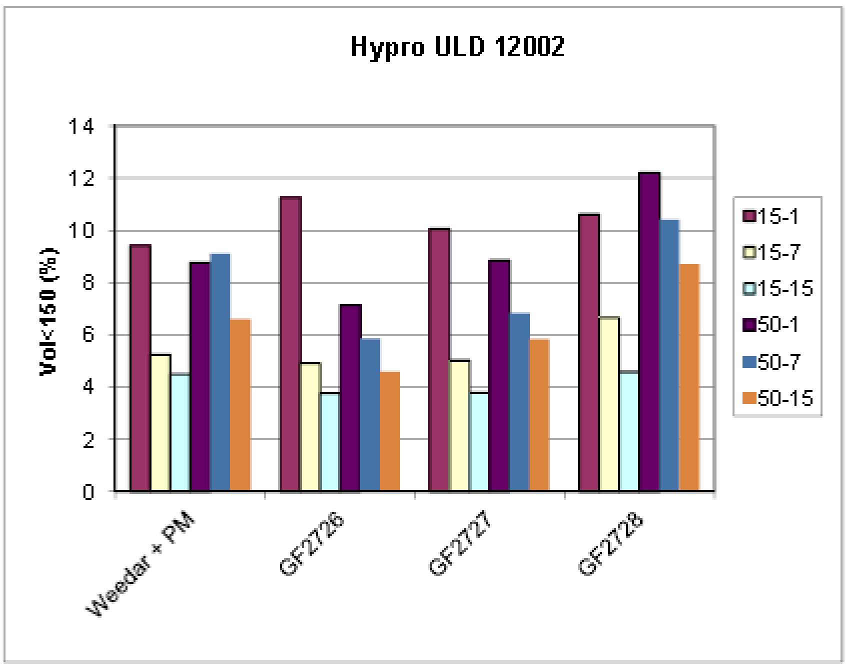


Figure 2. The droplet size data for Volume Median Diameter ($D_{v0.5}$) and the percent spray volume contained in droplets with diameter below 150 µm for nozzle ULD 12002 using various tank mixes at 15 and 50 cm sampling distances at 1, 7, 15 mph airspeed

E. CONCLUSIONS

A wind tunnel study was conducted to evaluate droplet size spectra for four mixtures of 2,4-D choline and glyphosate using 4 different nozzles. The 4 nozzles were TeeJet Extended Range (XR), Turbo TeeJet (TT) and Air Induction Extended Range (AIXR) types, and a Hypro Ultra

Low Drift (ULD) design. Sampling for all spray solution/nozzle combinations were made at 3 different air speeds (1, 7, 15 mph) and 2 laser distances (15, 50 cm) from the nozzles in order to optimize droplet size sampling techniques for ground sprays. The Agency finds that the experiment meets the criteria for a scientifically valid study and provides **ancillary** information.

F. REFERENCES

Fritz, B.K. W.C. Hoffman, Czaczyk, W.E. Bagley, G. Kruger and R. Henry. 2012. Measurement and Classification Methods Using the ASAE S572.1 Reference Nozzle. J. of Plant Proc. Res., 52:447-457.

MRID 48844001. Havens, P.L., Hillger, D.E., Hewitt, A.J. and Kruger, G.R. 2012. Field spray drift determinations with GF-2726 and 2,4-D/Glyphosate tank mixes. Dow AgroSciences LLC, Indianapolis, Indiana

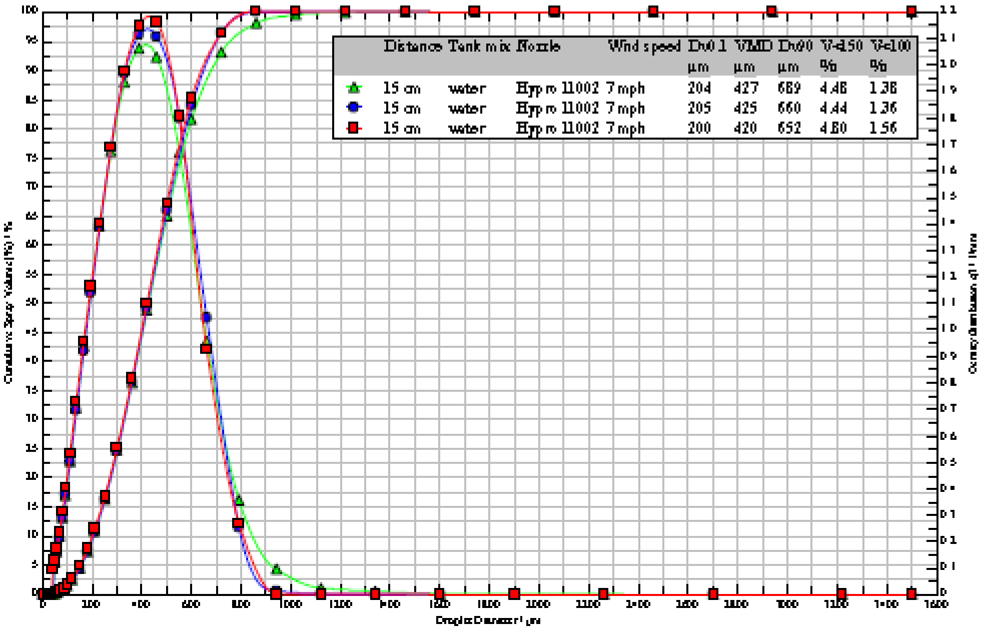
Appendix A. Table 1. Spray Droplet Distribution Analysis Results.

Spray Mixture	Nozzle	Downwind Distance (cm)	Air Speed (mph)	$D_{v0.1}$ (µm)	$D_{v0.5}$ (µm)	$D_{v0.9}$ (µm)	%Vol < 150 µm
Weedar+PM	XR	15	1	62	137	275	56.05
Weedar+PM	XR	15	7	66	163	312	44.98
Weedar+PM	XR	15	15	73	178	317	38.91
Weedar+PM	XR	50	1	84	167	280	41.03
Weedar+PM	XR	50	7	78	166	298	42.51
Weedar+PM	XR	50	15	80	187	305	34.89
Weedar+PM	TT	15	1	167	277	562	20.26
Weedar+PM	TT	15	7	118	285	508	16.79
Weedar+PM	TT	15	15	126	296	545	14.69
Weedar+PM	TT	50	1	114	213	399	22.23
Weedar+PM	TT	50	7	107	241	522	23.4
Weedar+PM	TT	50	15	113	237	447	20.4
Weedar+PM	AIXR	15	1	122	315	357	15.29
Weedar+PM	AIXR	15	7	132	309	545	13.25
Weedar+PM	AIXR	15	15	165	365	727	7.75
Weedar+PM	AIXR	50	1	127	267	501	14.8
Weedar+PM	AIXR	50	7	130	291	519	14.16
Weedar+PM	AIXR	50	15	155	341	572	9.27
Weedar+PM	Hypro	15	1	155	396	681	9.42
Weedar+PM	Hypro	15	7	192	411	678	5.24
Weedar+PM	Hypro	15	15	199	413	672	4.5
Weedar+PM	Hypro	50	1	155	294	608	8.77
Weedar+PM	Hypro	50	7	155	359	630	9.11
Weedar+PM	Hypro	50	15	173	381	666	6.59
GF-2726	XR	15	1	76	159	306	46.14
GF-2726	XR	15	7	88	199	337	31.54
GF-2726	XR	15	15	96	211	338	26.51
GF-2726	XR	50	1	79	152	256	49.04
GF-2726	XR	50	7	95	184	335	33.3
GF-2726	XR	50	15	103	193	317	27.91
GF-2726	TT	15	1	99	267	527	23.5
GF-2726	TT	15	7	117	295	531	16.83
GF-2726	TT	15	15	135	324	576	12.54
GF-2726	TT	50	1	113	222	382	21.2
GF-2726	TT	50	7	111	254	490	20.54
GF-2726	TT	50	15	119	270	509	17.6
GF-2726	AIXR	15	1	158	356	571	8.9

Spray Mixture	Nozzle	Downwind Distance (cm)	Air Speed (mph)	$D_{v0.1}$ (µm)	$D_{v0.5}$ (µm)	$D_{v0.9}$ (µm)	%Vol < 150 µm
GF-2726	AIXR	15	7	165	370	682	7.88
GF-2726	AIXR	15	15	188	404	796	5.35
GF-2726	AIXR	50	1	133	260	498	13.99
GF-2726	AIXR	50	7	167	345	576	7.09
GF-2726	AIXR	50	15	182	375	619	5.78
GF-2726	Hypro	15	1	142	383	690	11.25
GF-2726	Hypro	15	7	199	417	665	4.91
GF-2726	Hypro	15	15	215	427	664	3.76
GF-2726	Hypro	50	1	167	320	618	7.13
GF-2726	Hypro	50	7	184	422	701	5.86
GF-2726	Hypro	50	15	204	450	765	4.59
GF-2727	XR	15	1	87	161	280	43.18
GF-2727	XR	15	7	93	207	342	28.39
GF-2727	XR	15	15	104	216	334	22.53
GF-2727	XR	50	1	77	159	372	45.49
GF-2727	XR	50	7	101	190	321	28.22
GF-2727	XR	50	15	89	189	328	31.52
GF-2727	TT	15	1	96	254	516	24.57
GF-2727	TT	15	7	118	289	523	16.73
GF-2727	TT	15	15	130	302	563	13.93
GF-2727	TT	50	1	104	204	366	25.86
GF-2727	TT	50	7	104	241	477	23.79
GF-2727	TT	50	15	109	249	460	20.89
GF-2727	AIXR	15	1	156	365	634	9.18
GF-2727	AIXR	15	7	187	389	629	5.82
GF-2727	AIXR	15	15	197	404	708	4.49
GF-2727	AIXR	50	1	140	282	547	12.06
GF-2727	AIXR	50	7	177	367	607	6.31
GF-2727	AIXR	50	15	183	385	636	5.98
GF-2727	Hypro	15	1	150	395	671	10.05
GF-2727	Hypro	15	7	195	415	667	5.02
GF-2727	Hypro	15	15	210	416	650	3.79
GF-2727	Hypro	50	1	155	294	616	8.85
GF-2727	Hypro	50	7	173	396	650	6.82
GF-2727	Hypro	50	15	187	427	699	5.84
GF-2728	XR	15	1	62	138	295	55.71
GF-2728	XR	15	7	66	161	320	45.73
GF-2728	XR	15	15	71	174	324	40.09
GF-2728	XR	50	1	73	145	238	53.2

Spray Mixture	Nozzle	Downwind Distance (cm)	Air Speed (mph)	$D_{v0\ 1}$ (µm)	$D_{v0\ 5}$ (µm)	$D_{v0\ 9}$ (µm)	%Vol < 150 µm
GF-2728	XR	50	7	74	158	261	45.9
GF-2728	XR	50	15	81	173	302	38.5
GF-2728	TT	15	1	99	255	544	23.85
GF-2728	TT	15	7	112	281	520	19.15
GF-2728	TT	15	15	127	313	581	14.59
GF-2728	TT	50	1	88	181	415	37.2
GF-2728	TT	50	7	110	232	498	21.6
GF-2728	TT	50	15	114	234	491	20.4
GF-2728	AIXR	15	1	108	293	605	19.93
GF-2728	AIXR	15	7	143	335	552	10.95
GF-2728	AIXR	15	15	167	365	605	7.72
GF-2728	AIXR	50	1	113	233	401	19.7
GF-2728	AIXR	50	7	122	269	496	16.6
GF-2728	AIXR	50	15	138	304	504	12
GF-2728	Hypro	15	1	146	377	661	10.61

Appendix B. Example of Sympatec Laser particle Size Analyzer Reports



SPRAYER, R7: 0.5/18.0...3500µm 2011-01-24, 14:1.:..,...H2O

$D_{v0.1}$= 202.77 +/- 2.38 µm **VMD= 423.96 +/- 3.27 µm** **$D_{v0.9}$= 666.97 +/- 19.71 µm**

conditions:
Study: Dow
A.I. Product: water
Crop oil/ 10gals:
Adjuvant/ 10gals:

conditions:
Nozzle: Hypro 11002
Pressure: 2.76 bar
Wind speed: 7 mph

cumulative distribution with standard deviation

Diam. µm	Cum. Vol%	Std Dev.%abs	Diam. µm	Cum. Vol%	Std Dev.%abs	Diam. µm	Cum. Vol%	Std Dev.%abs
18.00	0.00	0.00	120.00	2.45	0.14	860.00	99.24	1.18
22.00	0.00	0.00	150.00	4.57	0.20	1020.00	99.78	0.37
26.00	0.00	0.00	180.00	7.38	0.25	1220.00	99.93	0.13
30.00	0.00	0.00	210.00	10.83	0.28	1460.00	100.00	0.00
36.00	0.00	0.00	250.00	16.40	0.31	1740.00	100.00	0.00
44.00	0.02	0.04	300.00	24.81	0.33	2060.00	100.00	0.00
52.00	0.12	0.05	360.00	36.55	0.43	2460.00	100.00	0.00
62.00	0.28	0.06	420.00	49.18	0.66	2940.00	100.00	0.00
74.00	0.55	0.07	500.00	65.94	1.18	3500.00	100.00	0.00
86.00	0.90	0.08	600.00	83.49	1.87			
100.00	1.43	0.11	720.00	95.17	1.94			

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

PC Codes: 051505
DP Barcodes: D402860, D403363, D 414416, D405216

Date: November18, 2013

MEMORANDUM

Subject: **Reviews of Environmental fate studies of 2,4-D Choline**

To: Michael Walsh, Chemical Review Manager
Kathryn Montague, Risk Manager
Herbicide Branch-PM 23
Registration Division (7505P)
Office of Pesticide Programs

From: Faruque Khan, Ph.D., Senior Fate Scientist 11/18/13
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507P)

Approved By: Sujatha Sankula, Ph.D., Branch Chief 11/18/13
Monica Wait, Acting RAPL Monica Wait 11/18/13
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507P)

The Environmental Fate and Effects Division has reviewed several environmental fate studies submitted in support of product registration- section 3 of 2,4-D Choline salt. The results of the review are shown in the table below. Additional deficiencies and reviewer's comments can be found in Data Evaluation Record.

Table 1: Reviews of Environmental Fate Data for 2,4-D Choline

Guideline #	Data Requirement	MRID #	Major Deficiency	Study Classification
835.8100	Field Volatility	48862902 48912102[a]	-Test materials were not applied according to label directions -Pre-application monitoring was not performed -Soil descriptions of plot and plot histories were not reported	Supplemental
840-1200	Spray Drift Field Deposition	48844001	- Maximum label rate was not reported - Discrepancies on the report length and conditions of sample storage sample storage	Supplemental

Table 1: Reviews of Environmental Fate Data for 2,4-D Choline				
Guideline #	Data Requirement	MRID #	Major Deficiency	Study Classification
None	Wind Tunnel Droplet Size Measurement of sprays	48862901	None	Ancillary
[a] MRID 48912102 is an updated version of MRID 4882902. No DER is prepared for MRID 48862902				

Test Material: 2,4-D

MRID 48912102

Title: Updated Report: Field volatility of different 2,4-D forms.

EPA PC Code: 051505

OCSPP Guideline: 835.8100

For CDM Smith

Primary Reviewer: Dan Hunt **Signature:** Dan Hunt

Date: 10/22/13

Secondary Reviewer: Joan Harlin **Signature:** Joan Harlin

Date: 10/22/13

QC/QA Manager: Joan Gaidos **Signature:** Joan G

Date: 10/22/13

Field Volatility of 2,4-D

Report:	MRID 48912102[1]. Havens, P.L., Hillger, D.E. and Cryer, S.A. 2012. Updated Report: Field volatility of different 2,4-D forms. Unpublished study performed by Dow AgroSciences LLC, Indianapolis, Indiana; Paragon Research, Zionsville, Indiana; and Product Safety Labs, Dayton, New Jersey; sponsored and submitted by Dow AgroSciences LLC, Indianapolis, Indiana (p. 3). Study No. 120931. Experiment initiation August 7, 2010 (p. 20); experiment completion date was not reported. Report issued August 20, 2012.
Document No.:	MRID 48912102
Guideline:	OCSPP 835.8100
Statements:	The study was not conducted in compliance with USEPA FIFRA GLP standards and exceptions to FIFRA standards were not noted (p. 3). Signed and dated Data Confidentiality, GLP Compliance, and Quality Assurance statements and Signature page were provided (pp. 2-5); a Certification of Authenticity statement was not provided.
Classification:	Test materials were not applied according to label directions; pre-application monitoring was not performed; storage stability was not determined; Soil descriptions of plot and plot histories were not reported. No significant deviations from good scientific practices were noted. This study is classified as **supplemental**.
PC Code:	051505
Reviewer:	Faruque Khan, Senior Scientist

Signature: Faruque A. Khan

Date: 11/18/13

This study measured the air concentrations and determined the flux following application of 2,4-D ethylhexyl ester (EHE), 2,4-D dimethylamine salt (DMA) and 2,4-D choline salt to plots in Indiana (2 locations), Arkansas and Georgia. However, the focus of this review was vapor flux determination from various locations.

1 Initially MRID 48862902 was submitted by Dow AgroSciences LLC, Indianapolis, Indiana Study No. 121712.

Executive Summary

Spray drift of the experimental formulation GF-2726 containing Colex D™ Technology, which is a premixture of 2,4-D choline salt and glyphosate dimethylamine salt, was compared to an in-tank mixture of Roundup PowerMax® (glyphosate) plus DMA® 4 IVM (2,4-D amine). Applications were made to two rectangular plots measuring 180 x 460 ft and 180 x 535 ft near McCook, Nebraska over a three-day period, September 21-September 23, 2011, with fresh tank mixes prepared each day. Rhodamine WT dye was added to the tanks as a conservative tracer. Test applications were made at a target application rate of 0.75 lb a.e./A for 2,4-D and were only carried out when the prevailing wind direction was from the west. A total of 37 treatments were made, 19 with the in-tank mixture and 18 with GF-2726. Three different nozzle types were studied: Extended Range flat fan (XR), Air Induction Extended Range (AIXR) and Turbo Tee Air Induction (TTI).

In-swath samplers (open polyethylene 150 x 15 mm Petri plates), located within the treated plots, were placed at *ca*. 15, 45, 75, 105, 135 and 165 feet upwind from the eastern edge of the plot, with additional deposition samplers placed along three down-wind sampling lines located at *ca*. 0, 5, 10, 25, 50, 100, 250 and 400 ft from the swath edge. A single sampler was placed *ca*. 25 feet upwind of the center of the upwind edge of the plot. Samplers were collected beginning *ca*. 5 minutes following application and analyzed for 2,4-D by LC/MS/MS following extraction. Rhodamine WT fluorescence was performed using a fluorometer.

The experimental formulation GF-2726 with Colex-D™ technology offered substantial drift reduction in the standard XR nozzles and AIXR nozzles, with drift reduction of 48% and 66%, respectively, at a distance of 100 feet downwind. Compared to the in-tank mixture, a reduction in deposition was not observed for GF-2726 at either 100 or 250 feet for the TTI nozzle.

I. Materials and Methods

A. Materials:

1. **Test Material:** Product Name: <u>Treatment 1</u>: Experimental formulation GF-2726 containing Colex D™ Technology, which is a premix formulation of 2,4-D choline salt and glyphosate dimethylamine salt (p. 10).

   <u>Treatment 2</u>: Roundup PowerMax® (glyphosate) plus DMA® 4IVM (2,4-D amine; pp. 11-12)

   Formulation Type (*e.g.*, liquid or granular): Liquid.

   CAS #: 94-75-7 (2,4-Dichlorophenoxyacetic acid; Appendix A, p. 58).

2. Storage Conditions: Not reported.

B. Study Design:

1. Site Description:

The study site was located on agricultural land *ca*. 2 miles north of McCook, Nebraska (p. 11). The field measured *ca*. 600 x 2,600 ft (32 acres) and was not currently planted, with winter wheat stubble *ca*. 14 inches high from the prior season.

2. Experimental Design:

Spray drift of the experimental formulation GF-2726 was compared to an in-tank mixture of the compounds (pp. 9-11). Treatments were applied with two identical John Deere model 4730 self-propelled agricultural sprayers, each equipped with 54 spray nozzles spaced 20 inches apart across the length of the 90-ft spray boom, and set at a height of 50 inches above the ground. Each nozzle body had the capacity to hold five separate nozzle tip assemblies. In this study, drift was studied using three different nozzle types: Extended Range flat fan (XRC11004VP), Air Induction Extended Range (AIXR11004VP) and Turbo Tee Air Induction (TTI11004VP), with tips placed on three of the five positions on each nozzle body.

3. Application:

Applications were made to two rectangular plots measuring 180 x 460 ft ("Plot 1") and 180 x 535 ft ("Plot 3"; p. 12). Treatments tested were 1) GF-2726 at 2.92% with Rhodamine WT tracer at 0.2% and 2) glyphosate at 1.11% (Roundup PowerMax®, 540 g a.e./L) plus 2,4-D amine at 1.25% (DMA® 4 IVM, 456 g a.e./L) with Rhodamine WT at 0.2% (pp. 11-12). Test applications were made from a 800 gal stainless steel product tank placed on each sprayer to deliver 800 g a.e./ha of 2,4-D and 840 g a.e./ha of glyphosate (15 gal/A; p. 11). The system pressure was *ca*. 40 psi. The target 2,4-D concentration was *ca*. 5.7 g/L, corresponding to the target application rate of 0.75 lb a.e./A (p. 18).

Applications were made over a three-day period, September 21-September 23, 2011, with fresh tank mixes prepared each day (p. 18). 19 treatments were made with the tank mix of DMA4 IVM plus Roundup PowerMax (designated as TM in the table below) and 18 with GF-2726 (designated as GF in the table below); 12 treatments were made with both XR11004 and AIXR11004 nozzles and 13 treatments were made with TTI11004 nozzles. Applications were only carried out when the prevailing wind direction was from the west (p. 20). Each treatment is detailed in Table 1 (pp. 19-20) below.

Table 1. Treatment list.

29	
30	
31	
32	
33	

36	T[illegible]
37	T[illegible]

[1] The spray

the results

[2]Tank mix

Applications were verified using two lines of samplers located within each replicate plot (pp. 12-13). Each sampling line consisted of six samplers, placed at *ca*. 15, 45, 75, 105, 135 and 165 feet upwind from the eastern edge of the plot (see Attachment #3). Samples were collected in open polyethylene 150 x 15 mm Petri plates supported by wooden stakes and placed at the top of the wheat stubble (p. 13).

4. Meteorological Sampling:

Wind speed and direction, temperature and relative humidity were measured at *ca*. 3 m height mid-way between the two application plots, with averaged data points recorded every 30 seconds (p. 12).

5. Sampling:

Deposition samples were collected in open polyethylene 150 x 15 mm Petri plates that were placed upon metal vehicle license plates, supported by stakes, and extended to the top of the wheat stubble in the field (*ca*. 14 inches above ground level; p. 13). For each replicate plot, a single sampler was placed *ca*. 25 feet upwind of the center of the upwind edge of the plot and three downwind sampling lines were constructed with samplers placed at *ca*. 0, 5, 10, 25, 50, 100, 250 and 400 ft from the swath edge (see Attachment #3). Sampling lines were spaced *ca*. 50 ft apart.

Approximately 5 minutes following application, sampling crews (one person per line) collected the downwind samples beginning at the furthest downwind sampling point (p. 14).

6. Sample Handling and Storage Stability:

Samples were capped as they were collected, placed into plastic bags by sampling line and then placed into a box to protect the samples from sunlight (p. 14). At the end of each application day, the sample boxes were transported to the University of Nebraska-Lincoln West Central Research and Extension Center. The length of sample storage was not clear from the study report (see Deficiency #4).

7. Analytical Methodology:

- Extraction method:

  Plates were rinsed three times using 16.7 mL of 1:1 reagent methanol:water into high density polyethylene bottles (p. 16). Aliquots of 1 mL were taken for direct fluorescence measurement; if necessary, samples were diluted 9:1 with solvent.

- 2,4-D analysis:

  Aliquots of rinsate solutions were diluted with acidified (0.1% acetic acid) 50:50 methanol:water, vortexed, centrifuged and analyzed directly by LC with tandem mass spectral detection (Synergi Hydro-RP column, 75 x 4.6 mm, 4 µm; LC/MS/MS; p. 17; Appendix B, pp. 69-70).

- Method validation (Including LOD and LOQ):

  The method Limit of Detection (LOD) and Limit of Quantification (LOQ) for 2,4-D were 0.075 ppb and 0.125 ppb, respectively, which corresponds to *ca*. 0.0004% and 0.0006% of the nominal application rate of 800 g a.e./ha (p. 17).

- Rhodamine WT dye analysis:

  Rhodamine WT fluorescence was performed using a Trilogy Lab Fluorometer (Turner Designs, Sunnyvale, CA) operated in raw fluorescence mode (p. 16). Measurement was performed using 4.5 mL disposable methacrylate cuvettes (Fisher Scientific).

8. Quality Control for Sampling:

Mean method recoveries for 2,4-D from all fortification levels analyzed were between 81.4% and 104% (Appendix A, p. 59).

To determine the stability of Rhodamine WT in sunlight during conditions of collection and transport of samples, aliquots from triplicate tank mix samples were placed on a Petri dish and exposed to mid-afternoon sunlight for 15 or 30 minutes, then moved to storage for *ca*. 24 hours (p. 14). Recoveries averaged 99.0% and 95.7% for 15 minutes and 30 minutes of exposure, respectively (pp. 20-21; Table 3, p. 21).

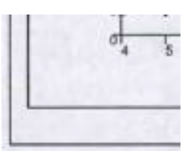
II. Results and Discussion

On application days, skies were clear to partly cloudy, with temperatures ranging from 59 to 82°F and wind speeds of 1.7 to 12.5 mph on September 21st, 1.7 to 15 mph on September 22nd and <1 to 10 mph on September 23rd, 2011 (p. 20). Wind was generally out of the west and in cases where the wind direction deviated beyond 34°, the results of that treatment were not used in the calculation of deposition statistics (6 of 37 treatments).

Overall average recovery of 2,4-D from the treated plots (in-swath) was 490 g a.e./ha which is 61.3% of the nominal application rate of 800 g/ha (p. 23). Average deposition for plots treated with GF-2726 was 505.6 g/ha for day-1, 388.3 g/ha for day-2 and 611.6 g/ha for day-3, and average deposition for plots treated with the in-tank mixture was 687.8 g/ha for day-1, 372.2 g/ha for day-2 and 440.3 g/ha for day-3 (Table 4, p. 24; Figure 5, p. 24). Study-author calculated off-target deposition rates were expressed as a fraction of the in-swath recovery.

Correlation of deposition with wind speed was studied at deposition distances of 100 and 250 feet (p. 25). Results indicated an inconsistent relationship between distances, nozzles and load types; however, the study authors postulated that this was likely due to the relatively small number of replicates for each treatment type, the low level of deposition observed and the relatively small range of wind speeds encountered during the study.

Figure 1: Relationship of deposition to wind speed at 100 feet downwind (pp. 26-27).



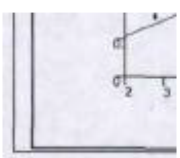
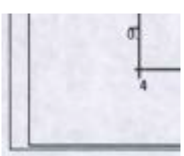
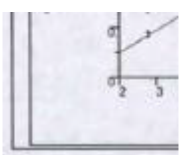


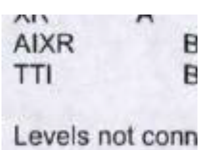
Figure 2: Relationship of deposition to wind speed at 250 feet downwind (pp. 28-29).

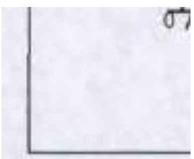




One-way analysis of means for each tank mix for both the 100- and 250-ft distances showed that there is a statistically significant difference between the deposition from the XR nozzle and the other two nozzles, but no real differences between the two air-induced nozzles for a given tank mix (p. 30; Figures 6-7, pp. 31-33).

Figure 3: Nozzle comparisons – 100 ft downwind (pp. 31-32).





AIXR	B
TTI	B

Levels not connec

Figure 4: Nozzle comparisons – 250 ft downwind (pp. 32-33).

XR	A	
AIXR		B
TTI		B

Levels not conne

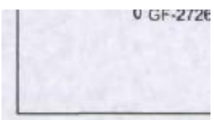
AIXR

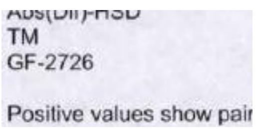
TTI

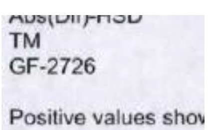
Levels not conr

One-way analysis of means for each tank mix for both the 100- and 250-ft distances showed that there is a statistically significant difference between the deposition of GF-2726 using Colex-D technology and the in-tank mixture using both the XR and AIXR nozzles (p. 30; Figures 8-9, pp. 33-36). There was no statistical difference shown for the TTI nozzle design. On average, at 100 feet, use of GF-2726 reduced deposition by 48% with an XR nozzle, while the average reduction was 66% with an AIXR nozzle

Figure 5: Tank load comparisons – 100 ft downwind (pp. 33-35).







Means Compar
Comparisons f
Abs(Dif)-HSD
GF-2726

Abs(Dif)-HSD	GF-2
TM	-0.0(

Positive values show pai

Figure 6: Tank load comparisons – 250 ft downwind (pp. 35-36).

Abs(Dif)-HSD
TM
GF-2726

Positive values shov

Means Compar
Comparisons f
Abs(Dif)-HSD

Abs(Dif)-HSD	
TM	-0.0C
GF-2726	0.0C

Positive values show pai

Abs(Dif)-HSD
GF-2726
TM

Positive values shov

Overall deposition curves demonstrate the reduction in deposition with the AIXR and TTI nozzles using both tank mix and GF-2726, with reduction in deposition of GF-2726 almost identical between the "very coarse" AIXR nozzles and "ultra coarse" TTI nozzle (p. 37; Figures 11-12, pp. 38-39). The drift reduction effectiveness of the Colex-D technology with XR and AIXR nozzles is illustrated in Figures 13-15 (pp. 40-42) of the study report.

Figure 7: Average deposition curves, Tank mix (pp. 37-38).

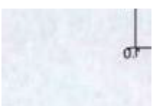


Figure 8: Average deposition curves, GF-2726 (p. 39).

Figure 9: Average deposition curves, XR nozzles (p. 40).

Figure 10: Average deposition curves, AIXR nozzles (p. 41).

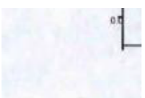
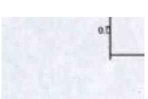


Figure 11: Average deposition curves, TTI nozzles (p. 42).



III. Study Deficiencies and Reviewer's Comments

1. Air samples were not collected. Guidance calls for air samplers to be placed at a 2– to 3–m height at a minimum of three downwind collection stations (for example, at 200, 600 and 1,000 ft (60, 80 and 300 m) downwind) to sample airborne particles of the chemical.

2. The maximum label rate was not reported. All test applications for spray drift field evaluations should be made at the maximum label-recommended pesticide dosages.

3. No evidence was shown that the Rhodamine dye did not interfere with chemical analysis or alter the properties of the spray. EPA accepts the use of dyes or other indicators with the pesticide if these materials do not interfere with chemical analysis, do not alter chemical or physical properties of the diluted spray, do deposit in direct proportion to concentrations of active ingredients, and do remain stable until analysis. Comparison of the dye and chemical assay results showed a high degree of linearity (r^2 = 0.983-0.984), indicating that the dye is well suited as a surrogate for the fractional deposition of the herbicide (Figures 3-4, pp. 22-23). The reviewer also notes that the Rhodamine dye was stable until analysis (pp. 20-21). Mean method recovery for 2,4-D was acceptable, 81.4-104%; however, samples were not fortified in the presence of Rhodamine dye (Appendix A, p. 59).

4. The length and conditions of sample storage were not clear from the study report. It was reported on page 14 of the study report that samples were typically stored 24 hours prior to analysis; however, the analytical start and termination dates were reported as October 3, 2011 and January 12, 2012, respectively, indicating that samples were stored for a minimum of 10 days from the date of the last test application (September 23, 2011; Table 1, p. 18; Appendix A, p. 55). It was reported in the analytical report that samples were stored refrigerated (*ca*. 5°C) prior to analysis (p. 14; Appendix A, p. 58).

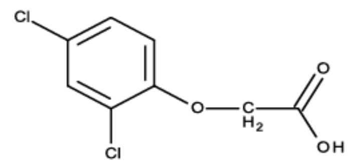
5. Deposition samplers were located a maximum of 400 feet from the test plot. EPA guidance specifies for collection surfaces to be located a minimum of 500 feet from the target area for ground applications.

6. The study authors stated that the conclusions were consistent with the observations from wind tunnel experiments, where TTI nozzles did not exhibit further drift reduction with the addition of Colex-D technology, and where the most significant mitigation was shown with AIXR-type nozzles, at the shortest downwind distances (p. 30).

IV. References

U.S. Environmental Protection Agency. 1998. Spray Drift Test Guidelines, OCSPP 840.1200, Spray Drift Field Dissipation. Office of Chemical Safety and Pollution Prevention, Washington, DC. EPA 712-C-98-112.

DER ATTACHMENT 1. 2,4-D and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
2,4-D (2,4-Dichlorophenoxy acetic acid)	**IUPAC:** (2,4-dichlorophenoxy)acetic acid **CAS:** 2-(2,4-dichlorophenoxy)acetic acid **CAS No.:** 94-75-7 **Formula:** $C_8H_6Cl_2O_3$ **MW:** 221.04 g/mol **SMILES:** O=C(O)COc(c(cc(c1)Cl)Cl)c1		840.1200 Spray drift	48844001	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS						
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

No statistics were performed by the reviewer.

Attachment 3: Spray Drift Study Design and Plot Maps

Figure 1, p. 13 in the study report.

Figure 2, p. 16 in the study report.

Test Material: 2,4-D

MRID 48912102

Title: Updated Report: Field volatility of different 2,4-D forms.

EPA PC Code: 051505

OCSPP Guideline: 835.8100

For CDM Smith

Primary Reviewer: Dan Hunt **Signature:** Dan Hunt

Date: 10/22/13

Secondary Reviewer: Joan Harlin **Signature:** Joan Harlin

Date: 10/22/13

QC/QA Manager: Joan Gaidos **Signature:** Joan Gx

Date: 10/22/13

Field Volatility of 2,4-D

Report:	MRID 48912102. Havens, P.L., Hillger, D.E. and Cryer, S.A. 2012. Updated Report: Field volatility of different 2,4-D forms. Unpublished study performed by Dow AgroSciences LLC, Indianapolis, Indiana; Paragon Research, Zionsville, Indiana; and Product Safety Labs, Dayton, New Jersey; sponsored and submitted by Dow AgroSciences LLC, Indianapolis, Indiana (p. 3). Study No. 120931. Experiment initiation August 7, 2010 (p. 20); experiment completion date was not reported. Report issued August 20, 2012.
Document No.:	MRID 48912102 (Initial submission was MRID 48862902)
Guideline:	OCSPP 835.8100
Statements:	The study was not conducted in compliance with USEPA FIFRA GLP standards and exceptions to FIFRA standards were not noted (p. 3). Signed and dated Data Confidentiality, GLP Compliance, and Quality Assurance statements and Signature page were provided (pp. 2-5); a Certification of Authenticity statement was not provided.
Classification:	Test materials were not applied according to label directions; pre-application monitoring was not performed; storage stability was not determined; Soil descriptions of plot and plot histories were not reported. No significant deviations from good scientific practices were noted. This study is classified as **supplemental**.
PC Code:	051505
Reviewer:	Faruque Khan, Senior Scientist

Signature: Faruque A. Khan

Date: 11/18/13

This study measured the air concentrations and determined the flux following application of 2,4-D ethylhexyl ester (EHE), 2,4-D dimethylamine salt (DMA) and 2,4-D choline salt to plots in Indiana (2 locations), Arkansas and Georgia. However, the focus of this review was vapor flux determination from various locations.

Executive Summary

Field volatilization of 2,4-D ethylhexyl ester (EHE), 2,4-D dimethylamine salt (DMA) and 2,4-D choline salt was examined from three bare plots in Fowler, IN and three cropped plots at Farmland, IN were established in 2010. In 2011, field volatilization experiments of 2,4-D were also conducted in cropped plots from Little Rock, AR and Ty Ty, GA. 2011 experiments included four treatments, adding a 2,4-D choline plus glyphosate experimental formulation to the treatment list, with all treatments being made to plant canopies.

Back-calculation method was used to estimate the vapor fluxes of the three forms of 2,4-D with time from the measured air concentrations and meteorological observations using ISCST3 air dispersion model. There are few discrepancies between the agency's and reported flux values. However, most of the reported and agency's flux values are in the same orders of magnitude. Discrepancies may have resulted from using the "Better Back-Calculation Method" used by the registrant, which accounts for potential cross-plot contamination within the location (e.g. Farmland, IN) whereas the agency estimated vapor fluxes were based on individual treatment site (e.g. 2,4-D choline, Farmland, IN).

The majority of 2,4-D mass loss occurred within 12 hours following application from all the treated plots. In 2010 trials, over the course of 65 hours of sampling, the reported loss of the EHE form of 2,4-D were 1.55% of applied from bare soil and 2.19% from soybean foliage. For the DMA salt, 0.62% and 1.58% was lost from bare soil and foliage respectively, while corresponding losses of the choline salt were 0.2% and 0.3% of applied. In 2011 treatments, over 72 hours of sampling, reported losses from soybean and cotton crop canopies were similar. Ester losses averaged 5.5% of applied, while DMA and choline salt losses averaged 1.32% and 0.096% respectively. Results show that greater reduction of volatile loss of the choline salt compared as compared to ester and the DMA salt form.

I. Materials and Methods

A. Materials:

1. **Test Material:** Product Name: Weedone LV4 EC (2,4-D EHE; p. 20).
   Formulation Type (*e.g.*, liquid or granular): Emulsifiable concentrate.
   CAS #: Not reported.
   Storage stability: Not reported.

   Product Name: Weedar 64 (2,4-D DMA; p. 20).
   Formulation Type (*e.g.*, liquid or granular): Not reported.
   CAS #: Not reported.
   Storage stability: Not reported.

   Product Name: Dow AgroSciences experimental formulation GF-2654 (2,4-D choline salt; p. 20).
   Formulation Type (*e.g.*, liquid or granular): Not reported.
   CAS #: Not reported.
   Storage stability: Not reported.

Product Name: Dow AgroSciences experimental formulation GF-2726 (2,4-D choline salt + glyphosate DMA; p. 20).
Formulation Type (*e.g.*, liquid or granular): Not reported.
CAS #: Not reported.
Storage stability: Not reported.

2. Storage Conditions: Not reported.

B. Study Design:

1. Site Description:

The four study sites were located at the Dow AgroSciences Midwest Field Experiment Station near Fowler, Indiana (Site 1); the Purdue University Davis Experimental Farm near Farmland, Indiana (Site 2); and at privately-owned sites near Little Rock, Arkansas (Site 3) and Ty Ty, Georgia (Site 4; pp. 11-12). Three treatment plots were established at each site in 2010 and four treatment plots were established at each site in 2011. Test plots at Site 1 were recently-tilled bare soil. Plots were cropped with soybeans at Site 2 (*ca*. 30 cm high, *ca*. 80% canopy) and at Site 3 (12-15 cm high, *ca*. 15% canopy). At Site 4, plots were cropped with cotton (*ca*. 50 cm tall, *ca*. 40% canopy). Plots were roughly square but differed in size (see Table 1). Soil texture and series information are provided in Table 3; however, other soil properties were not provided. Plot histories were not reported.

2. Application Details:

Application rate(s): 2,4-D was applied at rates ranging from 0.46 to 9.19 kg 2,4-D a.e./ha (0.41-8.20 lb 2,4-D a.e./A; reviewer-calculated), applied as 2,4-D choline (GF-2654), 2,4-D DMA, 2,4-D EHE or 2,4-D choline + glyphosate DMA (GF-2726; Tables 1-2, pp. 12-13; see Table 1 below). Application rates were not verified.

Irrigation and Water Seal(s): Plots were not irrigated.

Application Regime: The application rates and methods used in the study are summarized in **Table 1**.

Table 1. Summary of application methods and rates for 2,4-D

Site	Field	Treatment	Time of Application (Date (mm/dd/yy) and Start Time)	Amount 2,4-D Applied (lbs)	Area Treated (acres)[1]	Reported Application Rate (kg ae/ha)	Calculated Application Rate (lb ae/acre)[2]
1	1	2,4-D choline (GF-2654)	09/10/10 8:35 am	NR	4.27 (1.73 ha)	5.64	5.04
	2	2,4-D DMA	09/10/10 10:07 am	NR	4.25 (1.72 ha)	2.94	2.63
	3	2,4-D EHE	09/10/10 8:54 am	NR	0.62 (0.25 ha)	1.12	1.00
2	1	2,4-D choline (GF-2654)	08/07/10 9:30 am	NR	5.80 (2.35 ha)	4.48	4.00

Site	Field	Treatment	Time of Application (Date (mm/dd/yy) and Start Time)	Amount 2,4-D Applied (lbs)	Area Treated (acres)[1]	Reported Application Rate (kg ae/ha)	Calculated Application Rate (lb ae/acre)[2]
	2	2,4-D DMA	08/07/10 10:00 am	NR	5.80 (2.35 ha)	2.24	2.00
	3	2,4-D EHE	08/07/10 10:35 am	NR	0.62 (0.25 ha)	1.12	1.00
3	1	2,4-D choline (GF-2654)	07/12/11 6:38 am	NR	5.43 (2.2 ha)	4.48	4.00
	2	2,4-D choline + glyphosate DMA (GF-2726)	07/12/11 7:50 am	NR	5.51 (2.23 ha)	9.19	8.21
	3	2,4-D DMA	07/12/11 8:50 am	NR	5.43 (2.20 ha)	0.46	0.41
	4	2,4-D EHE	07/12/11 9:40 am	NR	0.59 (0.24 ha)	0.46	0.41
4	1	2,4-D choline + glyphosate DMA (GF-2726)	08/16/11 7:30 am	NR	5.48 (2.22 ha)	8.85	7.90
	2	2,4-D choline (GF-2654)	08/16/11 8:52 am	NR	5.48 (2.22 ha)	4.48	4.00
	3	2,4-D DMA	08/16/11 7:33 am	NR	5.48 (2.22 ha)	0.46	0.41
	4	2,4-D EHE	08/16/11 8:58 am	NR	0.64 (0.26 ha)	0.46	0.41

Data obtained from Tables 1-2, pp. 12-13 and pp. 20-21 in the study report. NR = Not reported. Site 1 = Fowler, Indiana; Site 2 = Farmland, Indiana; Site 3 = Little Rock, Arkansas; Site 4 = Ty Ty, Georgia.
1 Reviewer-calculated as hectare x 2.47 (ha shown in parentheses).
2 Reviewer-calculated from reported kg ae/ha data (kg ae/ha / 1.12).

Application Scheduling: Critical events of the study in relation to the application period are provided in **Table 2**.

Table 2a. Summary of 2,4-D application and monitoring schedule-Site 1 (Fowler, Indiana)

Field/Plot	Treated Acres	Application Period	Initial Air/Flux Monitoring Period	Water Sealing Period
1 – 2,4-D choline	4.27 (1.73 ha)	09/10/10 between 08:35 – 09:25	5 hours	Not performed
2 – 2,4-D DMA	4.25 (1.72 ha)	09/10/10 between 10:07 – 10:44	3 hours	Not performed
3 – 2,4-D EHE	0.62 (0.25 ha)	09/10/10 between 8:54 – 9:04	5 hours	Not performed

Data obtained from p. 20; Table 1, p. 12 and Table 12, pp. 27-28 in the study report.

Table 2b. Summary of 2,4-D application and monitoring schedule-Site 2 (Farmland, Indiana)

Field/Plot	Treated Acres	Application Period	Initial Air/Flux Monitoring Period	Water Sealing Period
1 – 2,4-D choline	5.80 (2.35 ha)	08/07/10 between 09:30 – 09:45	3 hours	Not performed
2 – 2,4-D DMA	5.80 (2.35 ha)	08/07/10 between 10:00 – 10:15	3 hours	Not performed
3 – 2,4-D EHE	0.62 (0.25 ha)	08/07/10 between 10:35 – 10:45	2 hours	Not performed

Data obtained from p. 20; Table 1, p. 12 and Table 11, p. 27 in the study report.

Table 2c. Summary of 2,4-D application and monitoring schedule-Site 3 (Little Rock, Arkansas)

Field/Plot	Treated Acres	Application Period	Initial Air/Flux Monitoring Period	Water Sealing Period
1 – 2,4-D choline	5.43 (2.2 ha)	07/12/11 between 06:38 – 07:25	5 hours	Not performed
2 – 2,4-D choline + glyphosate DMA	5.51 (2.23 ha)	07/12/11 between 07:50 – 08:30	3 hours	Not performed
3 – 2,4-D DMA	5.43 (2.20 ha)	07/12/11 between 08:50 – 09:20	3 hours	Not performed
4 – 2,4-D EHE	0.59 (0.24 ha)	07/12/11 between 09:40 – 09:55	2 hours	Not performed

Data obtained from p. 21; Table 2, pp. 12-13 and Table 13, pp. 28-29 in the study report.

Table 2d. Summary of 2,4-D application and monitoring schedule-Site 4 (Ty Ty, Georgia)

Field/Plot	Treated Acres	Application Period	Initial Air/Flux Monitoring Period	Water Sealing Period
1 – 2,4-D choline	5.48 (2.22 ha)	08/16/11 between 07:30 – 07:50	4 hours	Not performed
2 – 2,4-D choline + glyphosate DMA	5.48 (2.22 ha)	08/16/11 between 08:52 – 09:12	3 hours	Not performed
3 – 2,4-D DMA	5.48 (2.22 ha)	08/16/11 between 07:33 – 08:03	4 hours	Not performed
4 – 2,4-D EHE	0.64 (0.26 ha)	08/16/11 between 08:58 – 09:04	3 hours	Not performed

Data obtained from p. 21; Table 2, pp. 12-13 and Table 14, p. 29 in the study report.

Application Equipment:

Site 1: Two custom built research sprayers at 4.6-5.6 mph, 15-20 ft booms, 10 gal/A with AI11002 and AI110015 nozzles at 32-38 psi (very coarse droplets; p. 20).
Site 2: AGCO 4000 Series Spra-Coupe at 6.7 mph, 75 ft boom, 20 gal/A with AIXR 11004 nozzles at 50 psi (very coarse droplets; p. 20).
Site 3: Tractor-mounted 3-point hitch sprayer, 60 gallon cone sprayer at 7 mph, 20 ft spray width, 10 gal/A with AITTJ110-025 nozzles with 50 mesh screens at 37 psi 20-24 inches above the crop canopy; p. 21).
Site 4: John Deere HiBoy sprayer (GF-2726 and GF-2654 treatments) or tractor-mounted 3-point hitch sprayer (2,4-D DMA and 2,4-D EHE treatments; p. 21). Both at 4.25 mph, 17 gal/A with Greenleaf Air Mix 11025 nozzles at 39 psi with 50 mesh screens (p. 21).

Equipment Calibration Procedures: Not reported.

3. **Soil Properties:**

Soil properties measured before the study are provided in **Table 3**. Bulk density and percent sand, silt and clay values were not provided for any of the test plots. Plots of soil temperature and soil moisture were not included in the study report.

Table 3. Summary of soil properties for fields/plots

Site	Field	Sampling Depth (in)	FAO Soil Textural Classification	Bulk Density (g/cm^3)	% Organic Carbon Content	% Sand Content	% Silt Content	% Clay Content
1 Fowler, Indiana	1	NR	Drummer silty clay loam, 57%	NR	NR	NR	NR	NR
			Foresman silt loam, 18%	NR	NR	NR	NR	NR
			Warners variant silty clay, 21%	NR	NR	NR	NR	NR
			Whitaker silt loam, 3%	NR	NR	NR	NR	NR
	2	NR	Darroch silt loam, 1%	NR	NR	NR	NR	NR
			Drummer silty clay loam, 94%	NR	NR	NR	NR	NR
			Warners variant silty clay, 5%	NR	NR	NR	NR	NR
	3	NR	Blount silt loam, 31%	NR	NR	NR	NR	NR
			Pewamo silty clay loam, 69%	NR	NR	NR	NR	NR
2 Farmland, Indiana	1	NR	Blount silt loam, 54%	NR	NR	NR	NR	NR
			Pewamo silty clay loam, 46%	NR	NR	NR	NR	NR
	2	NR	Blount silt loam, 20%	NR	NR	NR	NR	NR
			Glynwood silt loam, 33%	NR	NR	NR	NR	NR
			Pewamo silty clay loam, 47%	NR	NR	NR	NR	NR
	3	NR	Blount silt loam, 31%	NR	NR	NR	NR	NR
			Pewamo silty clay loam, 69%	NR	NR	NR	NR	NR
3 Little Rock, Arkansas	1	NR	Hebert silt loam, 100%	NR	NR	NR	NR	NR
	2	NR	Hebert silt loam, 100%	NR	NR	NR	NR	NR
	3	NR	Hebert silt loam, 100%	NR	NR	NR	NR	NR
	4	NR	Hebert silt loam, 100%	NR	NR	NR	NR	NR
4 Ty Ty, Georgia	1	NR	Dothan loamy sand, 100%	NR	NR	NR	NR	NR
	2	NR	Tifton loamy sand, 100%	NR	NR	NR	NR	NR
	3	NR	Tifton loamy sand, 100%	NR	NR	NR	NR	NR
	4	NR	Ardilla loamy sand, 5%	NR	NR	NR	NR	NR
			Tifton loamy sand, 95%	NR	NR	NR	NR	NR

Data obtained from Tables 3-4, pp. 18-19 of the study report. NR = Not reported.

4. Meteorological Sampling:

Wind speed and direction, air temperature, barometric pressure, solar radiation and precipitation were collected at each test site at one-minute intervals (p. 22). Details of the sensor heights and the meteorological parameters for which data were collected are illustrated in **Table 4**. The location of the meteorological equipment for each field is shown in **Attachment 3**.

Table 4. Summary of meteorological parameters measured in the field

Site	Minimum Fetch[1]	Parameter	Monitoring heights (m)	Averaging Period
1	Not reported	Wind speed/Wind direction	Not reported	1 minute
		Ambient air temperature	Not reported	1 minute
		Solar radiation	Not reported	1 minute
		Precipitation	Not reported	1 minute
2	Not reported	Wind speed/Wind direction	Not reported	1 minute
		Ambient air temperature	Not reported	1 minute
		Solar radiation	Not reported	1 minute
		Precipitation	Not reported	1 minute
3	Not reported	Wind speed/Wind direction	Not reported	1 minute
		Ambient air temperature	Not reported	1 minute
		Solar radiation	Not reported	1 minute
		Precipitation	Not reported	1 minute
4	Not reported	Wind speed/Wind direction	Not reported	1 minute
		Ambient air temperature	Not reported	1 minute
		Solar radiation	Not reported	1 minute
		Precipitation	Not reported	1 minute

Data obtained from p. 22 in the study report. Site 1 = Fowler, Indiana; Site 2 = Farmland, Indiana; Site 3 = Little Rock, Arkansas; Site 4 = Ty Ty, Georgia.

5. <u>Air Sampling:</u>

Off-field air samples were collected from the eight cardinal and ordinal points of each plot located at 5 and 15 m from each treated field edge (16 samplers total per plot; p. 13; Figure 1, p. 14). Air samplers were mounted on posts and positioned at a height of 30 cm at Site 1, 50 cm at Site 2 (level with the top of the soybean canopy), 15 cm at Site 3 (at soybean canopy height) and 50 cm at Site 4 (cotton canopy height). Air samples were collected for *ca*. 3 days (68-71 hours) at each test site and for each treatment (Tables 11-14, pp. 27-29). Collection periods for each treatment are shown below. Pre-application monitoring was not performed.

Table 5. Sampling Periods.

Site	1 – Fowler, Indiana			2 – Farmland, Indiana		
Treatment	2,4-D choline	2,4-D DMA	2,4-D EHE	2,4-D choline	2,4-D DMA	2,4-D EHE
Period	Hours after treatment					
1	5	3	5	3	3	2
2	11	9	11	9	9	8
3	17	15	17	15	15	14
4	23	21	23	21	21	20
5	34	33	35	34	34	33
6	47	45	47	45	45	44
7	59	57	59	58	58	57
8	70	69	71	69	69	68

Site	3 – Little Rock, Arkansas				4 – Ty Ty, Georgia			
Treatment	2,4-D choline	2,4-D choline + glyphosate DMA	2,4-D DMA	2,4-D EHE	2,4-D choline	2,4-D choline + glyphosate DMA	2,4-D DMA	2,4-D EHE
Period	Hours after treatment							
1	5	3	3	2	4	3	4	3
2	10	9	9	8	10	9	10	9
3	16	15	15	14	16	15	16	15
4	23	22	21	20	22	21	22	21
5	36	35	34	34	36	35	36	35
6	47	46	45	44	47	46	47	46
7	60	58	58	57	60	59	60	59
8	71	69	69	68	71	70	71	70

Data obtained from Tables 11-14, pp. 27-29 in the study report.

6. **Sample Handling and Storage Stability:**

After collection in the field, samples were capped and placed in frozen storage as soon as practical (p. 22). The analytical method specified for storage at *ca*. −20°C prior to analysis (Appendix A, p. 60). The maximum storage interval for test samples was not reported and a storage stability study was not provided.

7. **Analytical Methodology:**

- Sampling Procedure and Trapping Material:

  Monitoring for 2,4-D was accomplished using XAD-2 (SKC Inc. Catalog No. 226-58) OSHA Versatile Sample vapor collection tubes attached to low-volume air sampling pumps (SKC model numbers 224-44XR, 224-PCXR8 and 224-52; pp. 13, 21-22). The front section of each tube contained 270 mg sorbent and the back section contained 140 mg. Air flow through the tube was calibrated to *ca*. 1 L/min at the beginning of each sampling period.

- Extraction Method:

  The XAD-2 resin from the sampling tubes, along with the foam plugs and cotton swabs used to wipe the inside of the sorbent tubes were extracted together by shaking for a minimum of 30 minutes with methanol:0.1N NaOH (90:10, v:v; p. 23; Appendix A, pp. 60-61). Following extraction, samples were centrifuged at 1000 rpm for five minutes or allowed to settle for a minimum of one hour.

- Method Validation (Including LOD and LOQ):

  The method Limit of Quantitation (LOQ) ranged from 1.25 to 5.0 ng 2,4-D per tube and the Limit of Detection (LOD) was *ca*. 0.75-1.5 ng/tube (p. 23). Method validation was not performed.

- Instrument Performance:

  Samples were analyzed by HPLC (Phenomenex Synergi Hydro-RP 80A column, 4.6 x 75 mm, 4 µm) using a mobile phase gradient of 0.10% acetic acid in water: 0.1% acetic acid in methanol (70:30 to 0:100 to 70:30, v:v) with negative-ion electrospray tandem mass spectrometry (p. 23; Appendix A, pp. 57-59, 62). A calibration curve was prepared from $^{13}C_6$-(2,4-dichlorophenoxy)acetic acid stable isotope internal standard solution at 0.000, 0.150, 0.250, 0.500, 1.25, 2.50, 5.00, 12.5, 25.0 and 50.0 µg/mL (Appendix A, p. 57).

8. **Quality Control for Air Sampling:**

Lab Recovery:	All lab recoveries, fortified at 5.0 or 50 ng/tube, were within the acceptable range of 90-110%, ranging from 94.8 to 110.84% (Appendix C, pp. 98-119).
Field blanks:	Pre-application samples were not collected.

Field Recovery: Field spikes were not prepared.

Travel Recovery: Travel spikes were not prepared.

Breakthrough: Not reported.

9. Application Verification:

Application rates were not verified.

10. Plant Bioassays:

At Site 1 (Fowler, Indiana), potted greenhouse cotton and grape plants were placed in and around treated areas *ca*. one hour after application (p. 23). Three grape plants and two cotton plants were placed at each air sampling station and nine grape and six cotton plants were placed inside the treated area for each treatment. Pots were separated from the soil using plastic liners. Following three days of exposure, plants were returned to the greenhouse and monitored for 25 days, being evaluated for epinasty and leaf malformation.

II. Results and Discussion

A. Empirical Flux Determination Method Description and Applicability:

Indirect Method

The indirect method, commonly referred to as the "back calculation" method, was the technique employed for estimating flux rates from fields treated with for this field study given the available data. In the indirect method, air samples are collected at various locations outside the boundaries of a treated field. Meteorological conditions, including air temperature, wind speed, and wind direction, are also collected for the duration of the sampling event. The dimensions and orientation of the treated field, the location of the samplers, and the meteorological information is used in combination with the ISCST3 dispersion model (Version 02035) and a unit flux rate of 0.001 $\mu g/m^{2\cdot}s$ to estimate concentrations at the sampler locations. Since there is a linear relationship between flux and the concentration at a given location, the results from the ISC model runs are compared to those concentrations actually measured and a regression is performed, using the modeled values along the x-axis and the measured values along the y-axis. If the linear regression does not result in a statistically significant relationship, the regression may be rerun forcing the intercept through the origin, or the ratio of averages between the monitored to modeled concentrations may be computed, removing the spatial relationship of the concentrations. The indirect method flux back calculation procedure is described in detail in Johnson et al., 1999.

B. Temporal Flux Profile:

Back-calculation method was used to estimate the vapor fluxes of the three forms of 2,4-D with time from the measured air concentrations and meteorological observations using ISCST-3 air dispersion model. There are few discrepancies between the agency's and reported flux values. However, most of the reported and agency's flux values are in the same orders of magnitude. Discrepancies may have resulted from using the "Better Back-Calculation Method" used by the registrant, which accounts for potential cross-plot contamination within the location (e.g. Farmland, IN) whereas the agency estimated vapor fluxes were based on individual treatment site (e.g. 2,4-D choline, Farmland, IN). The flux determined from the registrant and reviewer for each sampling period after the application is provided in **Tables 6 to 9**.

Table 6. 2,4-D volatility flux rate from soybean at Farmland, IN

Period[1]	Flux Rate (g/m^2-s)			
	Unadjusted Flux Rate[2]		Adjusted Flux Rate[3]	
	EPA	Registrant	EPA	Registrant
Field 1 (2,4 D choline)				
1	2.20E-08	1.80E-10	5.50E-09	4.50E-11
2	2.90E-10	1.60E-11	7.25E-11	4.00E-12
3	8.30E-12	1.40E-11	2.08E-12	3.50E-12
4	5.80E-12	5.00E-12	1.45E-12	1.25E-12
5	5.10E-10	3.50E-11	1.28E-10	8.75E-12
6	4.80E-11	1.50E-10	1.20E-11	3.75E-11
7	5.90E-10	1.60E-10	1.48E-10	4.00E-11
8	6.00E-11	1.10E-10	1.50E-11	2.75E-11
Field 2 (2,4-D DMA)				
1	6.00E-08	1.30E-08	3.00E-08	6.50E-09
2	1.60E-09	2.50E-11	8.00E-10	1.25E-11
3	2.20E-10	1.20E-10	1.10E-10	6.00E-11
4	8.00E-11	8.40E-11	4.00E-11	4.20E-11
5	1.20E-09	7.00E-10	6.00E-10	3.50E-10
6	1.50E-10	2.60E-10	7.50E-11	1.30E-10
7	3.40E-10	3.50E-10	1.70E-10	1.75E-10
8	1.40E-10	1.50E-10	7.00E-11	7.50E-11
Field 3 (2,4-D EHE)				
1	7.80E-08	7.60E-08	7.80E-08	7.60E-08
2	5.10E-08	4.00E-08	5.10E-08	4.00E-08
3	3.40E-09	5.40E-09	3.40E-09	5.40E-09
4	6.90E-09	2.80E-09	6.90E-09	2.80E-09
5	2.80E-08	2.50E-08	2.80E-08	2.50E-08
6	6.60E-09	2.70E-09	6.60E-09	2.70E-09
7	1.50E-08	4.40E-09	1.50E-08	4.40E-09
8	2.50E-09	3.20E-09	2.50E-09	3.20E-09

[1] = Air Monitoring Period (varies-2 to 11 hours)
[2]Flux rate based on application rate used in study
3 = Flux rate based on 1.0 lb a.e./A

Table 7. 2,4-D volatility flux rate from Bare field. Fowler, IN				
Period[1]	Flux Rate (g/m2-s)			
	Unadjusted Flux Rate[2]		Adjusted Flux Rate[3]	
	EPA	Registrant	EPA	Registrant
Field 1 (2,4-D Choline)				
1	7.70E-08	2.00E-08	1.53E-08	3.97E-09
2	9.30E-10	1.20E-09	1.85E-10	2.38E-10
3	6.20E-10	1.60E-10	1.23E-10	3.17E-11
4	6.90E-09	3.20E-09	1.37E-09	6.35E-10
5	2.60E-10	2.30E-10	5.16E-11	4.56E-11
6	1.60E-12	4.60E-12	3.17E-13	9.13E-13
7	5.20E-12	2.50E-11	1.03E-12	4.96E-12
8	3.30E-12	2.80E-12	6.55E-13	5.56E-13
Field 2 (2,4-D DMA)				
1	1.20E-07	5.60E-08	4.56E-08	2.13E-08
2	4.00E-09	5.40E-09	1.52E-09	2.05E-09
3	2.60E-10	3.50E-10	9.89E-11	1.33E-10
4	8.50E-09	4.80E-09	3.23E-09	1.83E-09
5	5.30E-10	3.30E-10	2.02E-10	1.25E-10
6	2.10E-12	9.00E-13	7.98E-13	3.42E-13
7	2.00E-11	6.40E-11	7.60E-12	2.43E-11
8	0.00E+00	1.00E-12	---	3.80E-13
Field 3 (2,4-D EHE)				
1	2.50E-08	3.60E-08	2.50E-08	3.60E-08
2	5.20E-09	5.70E-09	5.20E-09	5.70E-09
3	8.50E-10	1.10E-09	8.50E-10	1.10E-09
4	4.80E-09	5.50E-09	4.80E-09	5.50E-09
5	8.10E-09	3.20E-09	8.10E-09	3.20E-09
6	1.40E-09	6.20E-10	1.40E-09	6.20E-10
7	1.30E-09	2.30E-09	1.30E-09	2.30E-09
8	7.80E-11	2.30E-11	7.80E-11	2.30E-11

[1] = Air Monitoring Period (varies-5 to 11 hours)
[2] =Flux rate based on application rate used in study
[3] = Flux rate based on 1.0 lb a.e./A

Table 8. 2,4-D volatility flux rate from soybean at Little Rock, AR				
Period[1]	Flux Rate (g/m2-s)			
	Unadjusted Flux Rate[2]		Adjusted Flux Rate[3]	
	EPA	Registrant	EPA	Registrant
Field 1 (2,4-D Choline)				
1	7.50E-08	1.50E-08	1.88E-08	3.75E-09
2	2.10E-09	2.70E-09	5.25E-10	6.75E-10
3	3.30E-10	4.00E-10	8.25E-11	1.00E-10

Table 8. 2,4-D volatility flux rate from soybean at Little Rock, AR

Period[1]	Flux Rate (g/m2-s)			
	Unadjusted Flux Rate[2]		Adjusted Flux Rate[3]	
	EPA	Registrant	EPA	Registrant
4	1.30E-10	1.40E-10	3.25E-11	3.50E-11
5	6.10E-09	6.60E-10	1.53E-09	1.65E-10
6	2.10E-10	2.40E-10	5.25E-11	6.00E-11
7	2.00E-10	2.50E-10	5.00E-11	6.25E-11
8	1.20E-10	1.40E+10	3.00E-11	3.50E+09
Field 2 (2,4 D choline plus glyphosate DMA)				
1	2.00E-08	6.00E-08	2.44E-09	7.31E-09
2	3.40E-09	6.00E-09	4.14E-10	7.31E-10
3	4.40E-10	6.40E-10	5.36E-11	7.80E-11
4	1.80E-10	2.00E-10	2.19E-11	2.44E-11
5	3.90E-09	2.30E-09	4.75E-10	2.80E-10
6	1.20E-10	1.60E-10	1.46E-11	1.95E-11
7	3.00E-10	4.20E-10	3.65E-11	5.12E-11
8	9.80E-11	1.50E-10	1.19E-11	1.83E-11
Field 3 (2,4 D DMA)				
1	3.70E-08	3.00E-08	9.02E-08	7.32E-08
2	3.00E-09	4.00E-09	7.32E-09	9.76E-09
3	3.40E-10	6.10E-10	8.29E-10	1.49E-09
4	9.10E-11	1.70E-10	2.22E-10	4.15E-10
5	3.70E-09	6.50E-10	9.02E-09	1.59E-09
6	1.60E-10	1.50E-10	3.90E-10	3.66E-10
7	1.30E-10	1.90E-10	3.17E-10	4.63E-10
8	8.30E-11	9.30E-11	2.02E-10	2.27E-10
Field 4 (2,4 D EHE)				
1	3.50E-08	1.70E-07	8.54E-08	4.15E-07
2	2.60E-08	6.70E-09	6.34E-08	1.63E-08
3	2.60E-09	5.80E-10	6.34E-09	1.41E-09
4	1.20E-09	1.90E-09	2.93E-09	4.63E-09
5	9.60E-09	3.60E-09	2.34E-08	8.78E-09
6	7.20E-09	1.30E-09	1.76E-08	3.17E-09
7	5.80E-10	6.20E-10	1.41E-09	1.51E-09
8	7.30E-10	3.70E-10	1.78E-09	9.02E-10

[1] Air Monitoring Period (varies-5 to 11 hours)
[2] = Flux rate based on application rate used in study
[3] = Flux rate based on 1.0 lb a.e./A

Table 4. 2,4-D volatility flux rate from cotton field at Ty Ty, Ga

Period[1]	Flux Rate (g/m2-s)	
	Unadjusted Flux Rate[2]	Adjusted Flux Rate[3]

	EPA	Registrant	EPA	Registrant
Field 1 (2,4 D choline plus glyphosate DMA))				
1	1.17E-08	6.00E-10	1.48E-09	7.59E-11
2	2.83E-09	5.00E-09	3.58E-10	6.33E-10
3	1.25E-09	6.00E-10	1.58E-10	7.59E-11
4	3.16E-10	1.00E-10	4.00E-11	1.27E-11
5	4.84E-10	8.00E-10	6.13E-11	1.01E-10
6	1.10E-10	1.00E-10	1.39E-11	1.27E-11
7	2.94E-10	5.00E-10	3.72E-11	6.33E-11
8	9.87E-11	1.00E-10	1.25E-11	1.27E-11
Field 2 (2,4 D choline				
1	1.05E-08	3.00E-09	2.63E-09	7.50E-10
2	1.01E-09	7.00E-10	2.53E-10	1.75E-10
3	3.11E-10	3.00E-11	7.78E-11	7.50E-12
4	1.16E-10	7.50E-11	2.90E-11	1.88E-11
5	5.50E-10	2.00E-10	1.38E-10	5.00E-11
6	2.76E-10	3.50E-11	6.90E-11	8.75E-12
7	5.38E-10	2.50E-10	1.35E-10	6.25E-11
8	8.83E-11	5.50E-11	2.21E-11	1.38E-11
Field 3 (2,4 D DMA)				
1	1.23E-08	1.00E-08	3.00E-08	2.44E-08
2	5.85E-09	1.00E-08	1.43E-08	2.44E-08
3	8.65E-10	3.50E-10	2.11E-09	8.54E-10
4	1.38E-10	1.50E-10	3.37E-10	3.66E-10
5	6.35E-11	3.50E-10	1.55E-10	8.54E-10
6	7.50E-11	7.50E-11	1.83E-10	1.83E-10
7	2.75E-10	4.00E-10	6.71E-10	9.76E-10
8	7.33E-11	8.00E-11	1.79E-10	1.95E-10
Field 4 (2,4 D EHE)				
1	5.88E-09	3.00E-09	1.43E-08	7.32E-09
2	4.29E-08	3.00E-08	1.05E-07	7.32E-08
3	2.05E-08	5.00E-09	5.00E-08	1.22E-08
4	8.10E-09	3.00E-09	1.98E-08	7.32E-09
5	1.38E-08	7.00E-09	3.37E-08	1.71E-08
6	1.39E-09	3.50E-10	3.39E-09	8.54E-10
7	2.02E-09	1.20E-09	4.93E-09	2.93E-09
8	8.50E-10	4.00E-10	2.07E-09	9.76E-10

[1] Air Monitoring Period (varies-3 to 13 hours)
[2] = Flux rate based on application rate used in study
[3] = Flux rate based on 1.0 lb a.e./A

III. Study Deficiencies and Reviewer's Comments

1. Test materials were not applied at the same rates across the four field sites (Tables 1-2, pp. 12-13). US EPA 835.8100 test guidelines state that the test substance should be applied to soil at the rate and by the method stated in the label directions for the pesticide. Additionally, the test applications were not confirmed by soil analysis.

2. Pre-application monitoring was not performed.

3. A storage stability study was not conducted to determine the stability of 2,4-D in the sampling tubes. Additionally, field/travel spikes were not performed. The longest storage interval of air samples was not reported.

4. Plot histories were not reported to allow the reviewer to determine whether closely related compounds have been applied to the treatment areas within the previous three years.

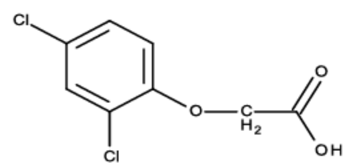
5. A control plot was not established.

6. Extensive validation of the back-calculation method to determine flux of volatile organic compounds from cropped plots has not been completed. Johnson et al., 1999 is only relevant for bare soil application. The use of ISCST3 may not account for different kinds of turbulence embedded in the wind caused by roughness from a number of different land surface types. However, the estimated flux values were statistically significant with the monitoring data.

IV. References

Johnson, B., Barry, T., and Wofford P. 1999. Workbook for Gaussian Modeling Analysis of Air Concentrations Measurements. State of California Environmental Protection Agency, Department of Pesticide Regulation. Sacramento, CA.

DER ATTACHMENT 1. 2,4-D and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
2,4-D (2,4-Dichlorophenoxy acetic acid)	**IUPAC:** (2,4-dichlorophenoxy)acetic acid **CAS:** 2-(2,4-dichlorophenoxy)acetic acid **CAS No.:** 94-75-7 **Formula:** $C_8H_6Cl_2O_3$ **MW:** 221.04 g/mol **SMILES:** O=C(O)COc(c(cc(c1)Cl)Cl)c1		835.8100 Field volatility	48912102	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS						
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

1. Validation spreadsheet for studies following the Indirect Method:

isc analysis.xlsx

Attachment 3: Field Volatility Study Design and Plot Maps

Plot schematic

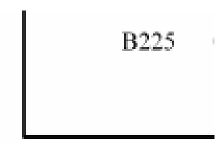


Figure 1, p. 14 in the study report.

Site 1 (Fowler, Indiana)

Figure 3, p. 16 in the study report.

Site 2 (Farmland, Indiana)

Figure 3, p. 18 in the study report.

Site 3 (Little Rock, Arkansas)

Figure 4, p. 17 in the study report.

Site 4 (Ty Ty, Georgia)

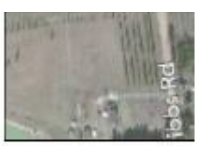


Figure 5, p. 18 in the study report.